

C725.01/H

CLAIMS

1. A machine for washing and/or cleaning articles, which comprises a sealable enclosure for containing the articles to which cleaning liquid is to be supplied, characterised in that the cleaning liquid is heated to a high temperature and forced into the enclosure under high pressure as finely dispersed or diffused droplets forming a mist or vapour so that a pressure greater than atmospheric is maintained in the enclosure to force the cleaning liquid into at least the surface if not through and into the very structure of the material from which the articles are formed, so as to assist the cleaning process, and wherein the enclosure is in the form of an elliptical capsule mounted for rotation about an axis through the mid-point of its longer axis, so that articles located therein will tend to fall from one end to the other as the capsule is rotated thereby to assist in the mixing of the liquids introduced into the capsule.
2. A machine as claimed in claim 1, wherein the cleaning liquid is removed from the articles and the interior of the enclosure by means of a suction pump and replaced by clean liquid for rinsing, and if desired also heated to higher than ambient temperatures.
3. A machine as claimed in claim 2, wherein the liquid supplied for rinsing is also at higher than atmospheric pressure.
4. A machine as claimed in claim 2 or 3, wherein the rinsing liquid is also heated above ambient temperature.
5. A machine as claimed in either of claims 3 or 4, wherein the rinsing liquid is removed from the enclosure by suction.

6. A machine as claimed in any of claims 1 to 5, wherein means is provided for extracting residual moisture from the articles in the form of a suction pump, wherein during a drying cycle following washing and/or a rinsing cycle suction is employed to reduce the pressure on the downstream side of the enclosure substantially below atmospheric, so that evaporative drying of moisture remaining on or in the material from which the articles are formed, occurs.
7. A machine as claimed in claim 6, wherein the vapour laden air produced by the evaporation is removed from the enclosure by the scavenging action of the air being drawn from the enclosure under the suction.
8. A machine as claimed in any of claims 1 to 7, wherein the enclosure comprises a rotatable drum, with a drive means for rotating the drum when in use and inlet and outlet means which permit relative movement to enable liquid and air to be supplied, to and drawn off therefrom, whilst the drum is rotating.
9. A machine as claimed in any of claims 1 to 7, wherein the enclosure comprises a housing within which a rotatable drum is mounted and the drum is adapted by means of openings to permit air and liquid to be forced axially and/or radially therethrough.
10. A machine as claimed in claim 9, wherein the openings comprise a large number of small apertures such as perforations in the wall of the drum.
11. A machine as claimed in claims 9 and 10, wherein the air and liquid mixture may be forced into the drum in a radial sense from the space around the drum within the housing, and be collected and conveyed away from the drum via a central porous or apertured hollow sleeve, mounted axially and centrally within the drum.
12. A machine as claimed in any of claims 9 to 11, wherein the housing forms part of the drum and rotate therewith, or is stationary so as to simplify the air and liquid supply to, and drainage from, the drum.

13. A machine as claimed in claim 1, wherein a reservoir is provided for containing a dry-cleaning fluid and valves and pumps are controlled by a computer to introduce a given value of the fluid into the under positive pressure after articles have been inserted, and the enclosure sealed to atmosphere and after rotation and thoroughly mixing the article, and the fluid, a suction pump is operated to evacuate the enclosure and remove the dry cleaning fluid and vapour therefrom.
14. A machine as claimed in any of claims 1 to 13, wherein the above atmospheric air pressure is obtained using an impeller, or turbine, or a centrifugal air pump.
15. A machine as claimed in any of claims 1 to 14, wherein the suction to produce depressed pressures below atmospheric is obtained using a venturi vacuum pump.
16. A machine as claimed in claim 15, wherein the venturi pump is a dual conical venturi jet high vacuum pump capable of generating a suction equivalent to 760mm Hg.
17. A machine as claimed in any of claims 1 to 16, wherein a filter is provided at the inlet to the enclosure and liquid is finely dispersed and/or diffused on entry into the enclosure by forcing it therethrough.
18. A machine as claimed in any of claims 1 to 17, wherein means is provided to mix the liquid with air at elevated pressure, and optionally desired elevated temperature, before being forced under pressure through the inlet filter.
19. A machine as claimed in either of claims 17 or 18, wherein the filter is a fine mesh filter.
20. A machine as claimed in claim 1, wherein the enclosure is in the form of an elliptical capsule mounted for rotation about an axis through the mid-point of the longer axis perpendicular to the latter and comprising a diameter of the cylindrical mid-region of

the capsule, so that articles located therein will tend to fall from one end to the other as the capsule is rotated and thereby assist in the mixing of the liquids introduced into the capsule during the washing or cleaning process and to agitate the articles excessively during the drying cycle to further assist in removing moisture therefrom.

21. A machine as claimed in claim 20, in which the capsule is to be loaded and unloaded through a circular opening in the front wall of a rectangular housing within which the capsule is located for rotation, and wherein the opening in the front housing wall is normally closed by a hinged circular door, the front opening (and in consequence the door also), is arranged coaxially relative to the axis of rotation of the capsule, and the capsule includes a circular opening which aligns with the circular front housing opening, and an annular seal is provided between the two openings to enable a positive pressure to be maintained in the capsule after the door has been closed.
22. A machine as claimed in claim 21, wherein a double door assembly is provided one closing an opening in the capsule wall and the other the opening in the front wall of the housing.
23. A machine as claimed in claim 22, wherein a seal is provided around each said door to seal it against the opening in the capsule wall, or the opening in the front housing wall, respectively.
24. A machine as claimed in any of claims 20 to 23, wherein valve means is provided to control the admission of liquid and air to the capsule after the openings have been sealingly closed.
25. A machine as claimed in claim 24, wherein the valve means comprises a solenoid valve.
26. A machine as claimed in any of claims 20 to 25, wherein the capsule is mounted for rotation by two rotary support bearing assemblies, one surrounding the loading and

unloading opening and the other attached to a diametrically opposite region of the cylindrical wall of the mid-region of the capsule coaxial with the first bearing assembly.

27. A machine as claimed in claim 26, wherein the second bearing assembly surrounds a circular region in the capsule wall opposite to the loading and unloading opening, and concentric pipe means having a rotary seal with the wall of the capsule, enables the capsule to rotate whilst still being connected to the liquid and air supplies and also allows liquid and air to enter the capsule whilst the latter rotates.
28. A machine as claimed in claim 27, wherein the pipe means communicates with one or more fine mesh filters to disperse and diffuse incoming high pressure liquid and air into a fine mist.
29. A machine as claimed in any of claims 24 to 28, wherein the valve means controlling the passage of liquid and air into the capsule is arranged adjacent the pipe means where it extends through the capsule wall and is attached to, or forms part, of the capsule wall.
30. A machine as claimed in claim 29, wherein the pipe means and valve is surrounded by and extends axially through a hollow cylindrical drive shaft carrying a large diameter pulley which shaft extends through a support bearing assembly at the rear of the capsule and is joined to the capsule wall, and an electric motor, whose output shaft carries a complementary pulley aligned with the first mentioned pulley, allows drive to be transmitted to the drive shaft from the motor via a drive band, to rotate the capsule about the support bearing axis.
31. A machine as claimed in claim 30, wherein the bearing assembly is a so-called split bearing and is mounted on a sub-frame within the housing.

32. A machine as claimed in any of claims 21 to 31, wherein the opposite ends of the capsule include sieve-type filters and the pipe means delivers liquid and air to the two filters to enter the interior of the capsule from opposite ends thereof.
33. A machine as claimed in any of claims 21 to 31, wherein a hollow cylindrical sleeve extends across the interior of the capsule coaxial with the aligned support bearing axes which define the axis of rotation of the capsule, and the sleeve wall is perforated with tiny apertures through which the liquid and air exit into the interior of the capsule as a fine mist diffused by the tiny perforations, which form a cylindrical fine mesh sieve type filter.
34. A machine as claimed in claim 32 or 33, wherein the fine mesh filter allows the incoming pressurized liquid and air to diffuse into the articles and produce a fast gaseous reaction inside the capsule due the liquid gaining heat energy by virtue of the liquid being forced through the plurality of tiny openings making up the filter mesh, so as to produce a sprinkler jet action for the gas-liquid mixture.
35. A machine for washing as claimed in any of claims 21 to 34, wherein a heater is provided to heat the water to boiling point so that at least part of the liquid entering the capsule is in the form of steam vapour.
36. A machine as claimed in any of claims 21 to 35, wherein the shape of the capsule ensures that articles and liquid are tumbled from one end to the other under gravity as the capsule is rotated.
37. A machine as claimed in any of claims 1 to 36, wherein the air expands due to its being heated after coming into contact with the steam so that a further increase in pressure within the capsule results causing the detergent suds to more thoroughly permeate the articles particularly where the latter are formed from woven fabric, so further assisting the release of dirt and particles causing stains and marks in the fabric.

38. A machine as claimed in any of claims 21 to 37 for washing articles, wherein access to the enclosure is via a top opening, means is provided to extract the liquid and air from the end of the capsule opposite to the end containing the sealable opening through which access can be gained to the interior of the capsule, so that the garments tend to gravitate towards the end opposite to the opening under the suction effect, and in this way the weight of the garments at that end will tend to ensure that the capsule will always come to rest with its end containing the access aperture uppermost and in alignment with an opening in the housing surrounding the capsule which in use will normally be closed by a lid.
39. A machine as claimed in any of the preceding claims 2 to 38, wherein the vacuum pump comprises a venturi tube includes a peripheral air duct, set around the outside of the venturi outlet, and this arrangement accelerates with flow, and the venturi tube is connected to a branch inlet at the mid point of a 90 degree radius bend relative to the centreline of the tube o/d to provide a strong vacuum suction, pump delivers water through the venturi supply tube, and an air blower outlet is connected via a pipe to the peripheral air chamber to control the air flow around the venturi, which in turn controls the amount of the suction.
40. A machine as claimed in claim 39, wherein an air pressure relief valve is provided which also controls the amount of suction created.
41. A machine as claimed in any of claims 21 to 40, wherein the vacuum, the temperature, and the pressure are displayed in an analogue or digital display (preferably an analogue LCD bar display) on the front of the machine housing.
42. A method of washing articles using a machine as claimed in any of claims 1 to 41, comprising the steps of:
- inserting an article or articles to be washed, into a sealable capsule,
 - sealing the capsule

- introducing a detergent solution at or around boiling point together with steam into the sealed capsule, under a pressure greater than ambient
- rotating the capsule to agitate the article(s) and effect a mixing of the liquid and steam therewith
- pumping the liquid from the capsule after a predetermined time
- introducing clean water into the capsule and further rotating same to rinse the articles
- pumping the rinsing water from the capsule after a predetermined time
- continuing to pump the capsule so as to lower the pressure therein to below atmospheric for a further predetermined period of time to assist in evaporative drying of the article(s) therein
- removing the article(s) after establishing ambient pressure in the capsule.

43. A method as claimed in claim 42, wherein the suction pumping of liquids and air is effected using a venturi suction pump.

44. A machine as claimed in any of claims 1 to 41 which includes a reservoir of a volatile cleaning fluid such as isopropyl alcohol, means for introducing the fluid into the capsule with one or more items of clothing or the like which are to be dry cleaned, means for sealing the capsule so as to provide a gas-tight compartment, means for rotating the capsule in the range 80-100rpm, prior to unsealing the capsule to remove the clothing or like articles, and suction pump means, particularly a venturi vacuum pump, for extracting vapours and gases left over from the cleaning process.

45. A machine for washing articles which comprises a sealable enclosure for containing the articles to which a mixture of detergent and water (washing liquid) is to be supplied, characterised in that the liquid is heated to a high temperature and forced into the enclosure under high pressure so as to form a two phase vapour or mist of finely dispersed or diffused droplets of liquid and steam, and a pressure greater than atmospheric is maintained in the enclosure to force the liquid into at least the surface if not through and into the very structure of the material from which the articles are formed, so as to assist the washing process.

46. A machine for washing and/or cleaning articles which comprises a sealable enclosure for containing the articles to which cleaning liquid is to be supplied, characterised in that the cleaning liquid is heated to a high temperature and forced into the enclosure under high pressure as finely dispersed or diffused droplets forming a mist or vapour so that a pressure greater than atmospheric is maintained in the enclosure to force the cleaning liquid into at least the surface if not through and into the very structure of the material from which the articles are formed, so as to assist the cleaning process, wherein the cleaning liquid is removed from the articles and from the interior of the enclosure by means of a suction pump.

47. A machine as claimed in claim 46 wherein the suction pump is a venturi pump and water supplied thereto under pressure by a pump (16), and after leaving the venturi pump, the water is conveyed to a sump (150) which includes a return pipe (154 for returning the water to the pump (116).

48. A method of washing articles comprising the steps of:

- inserting an article or articles to be washed into a sealable capsule,
- sealing the capsule, and further characterised by the steps of:-
- introducing a detergent solution at or around boiling point together with steam into the sealed capsule, under a pressure greater than ambient
- rotating the capsule to agitate the article(s) and effect a mixing of the liquid and steam therewith
- pumping the liquid from the capsule after a predetermined time
- introducing clean water into the capsule and further rotating same to rinse the articles
- pumping the rinsing water from the capsule after a predetermined time
- continuing to pump the capsule so as to lower the pressure therein to below atmospheric for a further predetermined period of time to assist in evaporative drying of the article(s) therein, and
- removing the article(s) after establishing ambient pressure in the capsule.

49. A method as claimed in claim 48, wherein the suction pumping of liquids and air is effected using a venturi suction pump.

50. A method as claimed in claim 48 or 49 wherein the water is mixed with detergent and the mixture is subsequently pressurised to a pressure above ambient prior to being introduced into the capsule.

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